CLAIMS

1. Process for preparing active polymer extrudate comprising polymer matrix and guest matter, the process comprising contacting a polymer substrate and guest matter with a plasticising fluid under dense phase, sub critical or supercritical plasticising conditions of elevated temperature and/or pressure to plasticise the polymer substrate and incorporate guest matter and extruding polymer substrate incorporating guest matter under dense phase, sub critical or supercritical conditions via an extrusion orifice into a collection zone or a mould with simultaneous or subsequent release of pressure, whereby extrudate is obtained comprising a solid admixture of polymer matrix and guest matter in form conferred by the orifice or the mould.

2. Process according to Claim 1 wherein extrudate is in the form of sheets, films, tubes, cylinders, rods, ribbons, fibrils, filaments, fibroids, fibres, mesh, woven or non-woven extrudates.

3. Process according to Claim 1 or 2 wherein plasticising fluid is selected from any dense phase, subcritical or supercritical fluid.

4. Process according to any of Claims 1 to 3 conducted in the substantial absence of additional solvent.

5. Process according to any of Claims 1 to 3 conducted for a plasticising time in the range 2 millisecond to 72 hours.

6. Process according to any of Claims 1 to 5 conducted at temperature in the range minus 200°C to plus 500°C.

7. Process for preparing active polymer extrudate comprising polymer matrix and guest matter, the process comprising contacting a polymer substrate and guest matter with a plasticising fluid under dense phase, sub critical or supercritical

plasticising conditions of elevated temperature and/or pressure to plasticise the polymer substrate and incorporate guest matter and extruding polymer substrate incorporating guest matter under dense phase, sub critical or supercritical conditions via an extrusion orifice into a collection zone or a mould with simultaneous or subsequent release of pressure, whereby extrudate is obtained comprising a solid admixture of polymer matrix and guest matter in form conferred by the orifice or the mould characterised in that the process is conducted at temperature of less than or equal to 200°C and/or less than the Tg, Tm or non-viscous state of the polymer substrate.

8. Process according to any of Claims 1 to 7 wherein plasticising conditions comprises a pressure from in excess of 1 bar to 1000 bar.

9. Process according to any of Claims 1 to 8 conducted with polymer substrate viscosity in the range 1 - 1,000,000 centipoises, more preferably 500 - 500,000 centipoises, more preferably 1000 - 100,000 centipoises.

10. Process according to any of Claims 1 to 9 conducted with polymer substrate of molecular weight in the range 1 to 10,000 kDa, preferably 1 to 250 kDa.

11. Process as claimed in any of Claims 1 to 10 wherein the polymer substrate comprises one or more polymers, which may be of same or different phase, same or different properties for example forming same or different porosity.

12. Process as claimed in Claim 11 wherein two or more polymer types are contacted with plasticizing fluid as discrete components and co-extruded to form a composite extrudate having two or more polymer layers or zones.

13. Process as claimed in any of Claims 1 to 12 wherein the guest matter comprises a single or plural guest entities.

14. Process as claimed in Claim 13 wherein plural guest entities comprise guest matter of one type for one intended function together with guest matter of another type for a same or different intended function, for example one or more drugs and one or more excipients.

15. Process according to any of Claims 1 to 14 conducted with orifice dimensions in the range 0.001-10 millimetre, preferably 0.001-2 millimetre and length in the range 0.1 millimetre to 1 metre.

16. Process according to any of Claims 1 to 15 conducted with orifice of increasing dimension along its length, preferably increasing at a first angle with respect to the axis and optionally at a second angle in respect to the axis at the orifice outlet.

17. Process as claimed in any of claims 1 to 16 wherein an orifice is one of a plurality of orifices which may be independent or which may be adjacently or coaxially or concentrically aligned to form a plurality of simple extrudates or to form a composite extrudate as hereinbefore defined, and may additionally or alternatively comprise a solid core or the like, whereby hollow extrudate is obtained for example an annular orifice may provide tubes or cylinders.

18. Process according to any one of Claims 1 to 17 conducted with continuous or intermittent extrusion of polymer substrate and guest matter.

19. Process according to any of Claims 1 to 18 wherein extrusion is into a collection zone at positive, ambient or negative pressure, which may be greater or less than the plasticising pressure and is preferably in the range 50 to 140 bar or in the range 1 to 50 bar.

20. Process according to any of Claims 1 to 19 wherein polymer substrate is selected from any amorphous, semi-crystalline or crystalline polymer, suitably polymers such as polyesters, poly (ortho esters), polyanhydrides, poly(amino acids),

poly(pseudo amino acids), polyphosphazenes, azo polymers; vinyl polymers poly(acrylic acid), poly(methacrylic acid), polyacrylamides, polymethacrylamides, polyacrylates, Poly(ethylene glycol), Poly(dimethyl siloxane), Polyurethanes, epoxy, bis-maleimides, methacrylates such as methyl or glycidyl methacrylate, Polycarbonates, Polystyrene and derivatives; carbohydrates, polypeptides and proteins; and copolymers thereof.

21. Process according to any of Claims 1 to 20 wherein guest matter is selected from biofunctional or non-biofunctional material including but not limited to:

(1) (pharmaceutical) drugs and veterinary products;

(2) agrochemicals as pest and plant growth control agents;

(3) human and animal healthcare products;

(4) human and animal growth promoting, structural, or cosmetic products including products intended for growth or repair or modelling of the skeleton, organs, dental structure and the like;

(5) absorbent biofunctional materials for poisons, toxins and the like;

(6) functioning matter such as any nutrient dependent, biological matter which is characterised by replication, division, regeneration, growth, proliferation or the like;

(7) organic or inorganic materials for use in dyeing, constructing textiles, electronic materials and the like;

(8) SMART materials.

(9) formulating agents which stabilise or enhance the functional material.

22. Process as claimed in any of claims 1 to 21 wherein guest matter is present in an amount of $1x10^{-12}$ to $1x10^{-6}$ or $1x10^{-6}$ to 1 wt%, more preferably in low volumes in the range $1x10^{-12}$ to $1x10^{-9}$, $1x10^{-9}$ to $1x10^{-6}$ or 0.01 or 0.1 to 1 wt%.

23. Process according to any of Claims 1 to 22 wherein plasticising fluid is selected from dense phase, sub or super critical carbon dioxide, di-nitrogen oxide, carbon disulphide, aliphatic C_{2-10} hydrocarbons such as ethane, propane, butane, pentane, hexane, ethylene, and halogenated derivatives thereof such as for example

carbon tetrafluoride or chloride and carbon monochloride trifluoride, and fluoroform or chloroform, C_{6-10} aromatics such as benzene, toluene and xylene, C_{1-3} alcohols such as methanol and ethanol, sulphur halides such as sulphur hexafluoride, ammonia, xenon, krypton and the like.

24. Polymer extrudate comprising polymer matrix and guest matter as hereinbefore defined in any of Claims 1 to 23 as a solid admixture in extrudate form.

25. Composition comprising polymer extrudate as hereinbefore defined in Claim 24 as a collection of extrudates together with suitable supports, binders, diluents, initiators, accelerators, hardeners, stabilisers, antioxidants, adhesion promoters, fillers and the like, or comprising individual extrudate for example as individual scaffolds and the like.

26. Apparatus for use in the preparation of polymer extrudate using the process as hereinbefore defined in any of Claims 1 to 23 comprising a pressure vessel adapted for temperature and pressure elevation which may comprise means for mixing the contents, and wherein the pressure vessel includes means for extruding contents via an orifice as hereinbefore defined into a second collection vessel at lower pressure.

27. Use of the extrudate or a composition thereof or a product of the process as hereinbefore defined as a controlled release device such as a drug delivery device; in Pharmaceutical or Veterinary applications for example as a human or animal health or growth promoting structural or cosmetic product, natural or artificial implant, drug delivery or DNA delivery device; as an anti-microbial for example having bacteria - static or -cidal activity; as a natural or synthetic barrier capable of immobilising e.g. naturally occurring or artificially introduced poisons or toxins by e.g. absorption, interaction or reaction; in Agrochemical or crop protection applications; in the processing of thermally labile fibres for use in dying, textiles, electronics etc below the polymer Tg, Tm or melt viscosity; in incorporation of dyes and other thermally labile materials into polymers that cannot be formed by traditional processes e.g.

melt extrusion and the like; or in incorporation of surfactants into fibres to control polymer properties.

28. Process for preparing polymer extrudate comprising contacting a polymer substrate with a plasticising fluid under dense phase, sub critical or supercritical plasticising conditions of elevated temperature and/or pressure to plasticise the polymer substrate and extruding polymer substrate under dense phase, sub critical or supercritical conditions via an extrusion orifice into a collection zone or a mould with simultaneous or subsequent release of pressure, whereby extrudate is obtained in form conferred by the orifice or the mould characterised in that the process is conducted at temperature of less than or equal to 200°C.

29. Process as claimed in Claim 28 wherein polymer substrate comprises a thermally labile polymer, for example, poly(acrylonitrile) and copolymers thereof.

30. Process, Extrudate, Composition, apparatus or use substantially as hereinbefore described, exemplified or illustrated in the description and drawings.

AMENDED CLAIMS

[Received by the International Bureau on 04 April 2005 (04.04.05): original claims 1 - 30 replaced by amended claims 1 - 25 (6 pages)]

1. Process for preparing active polymer extrudate comprising polymer matrix and guest matter, the process comprising contacting a polymer substrate and guest matter with a supercritical fluid under supercritical conditions of elevated temperature and/or pressure to plasticise the polymer substrate and incorporate guest matter and extruding polymer substrate incorporating guest matter under supercritical conditions via an extrusion orifice into a collection zone or a mould with simultaneous or subsequent release of pressure, whereby extrudate is obtained comprising a solid admixture of polymer matrix and guest matter in form conferred by the orifice or the mould wherein extrudate is in the form of tubes, cylinders, rods, ribbons, fibrils, filaments, fibroids or fibres.

2. Process for preparing active polymer extrudate comprising polymer matrix and guest matter, the process comprising contacting a polymer substrate and guest matter with a supercritical fluid under supercritical conditions of elevated temperature and/or pressure to plasticise the polymer substrate and incorporate guest matter and extruding polymer substrate incorporating guest matter under supercritical conditions via an extrusion orifice into a collection zone or a mould with simultaneous or subsequent release of pressure, whereby extrudate is obtained comprising a solid admixture of polymer matrix and guest matter in form conferred by the orifice or the mould wherein extrudate is in the form of sheets or films.

3. Process as claimed in Claim 1 or 2 for preparing extrudate suitable for topical, rectal, parenteral, mucosal, epicutaneous, subcutaneous, intravenous or intrarespiratory application route or as a structural implant in the human or animal body or in living matter.

4. Process according to any of Claims 1 to 3 conducted in the substantial absence of additional solvent.

5. Process according to any of Claims 1 to 4 conducted at temperature in the range 30°C to 55°C and less than or equal to 140°C.

6. Process for preparing active polymer extrudate comprising polymer matrix and guest matter, the process comprising contacting a polymer substrate and guest matter with a supercritical fluid under supercritical conditions of elevated temperature and/or pressure to plasticise the polymer substrate and incorporate guest matter and extruding polymer substrate incorporating guest matter under supercritical conditions via an extrusion orifice into a collection zone or a mould with simultaneous or subsequent release of pressure, whereby extrudate is obtained comprising a solid admixture of polymer matrix and guest matter in form conferred by the orifice or the mould in the form of tubes, cylinders, rods, ribbons, fibrils, filaments, fibroids or fibres characterised in that the process is conducted at temperature 30°C to 55°C and less than or equal to 140°C and less than the Tg, Tm or non-viscous state of the polymer substrate.

7. Process according to any of Claims 1 to 6 conducted with polymer substrate of molecular weight in the range 20 to 50 kDa or 50 to 200 kDa.

8. Process as claimed in any of Claims 1 to 7 wherein two or more polymer types are contacted with supercritical fluid as discrete components and co-extruded to form a composite extrudate having two or more polymer layers or zones.

9. Process as claimed in any of Claims 1 to 8 comprising plural guest entities comprising guest matter of one type for one intended function together with guest matter of another type for a same or different intended function, for example one or more drugs and one or more excipients.

10. Process according to any of Claims 1 to 9 conducted with orifice dimensions in the range 0.001-10 millimetre, preferably 0.001-2 millimetre and length in the range 0.1 millimetre to 1 metre.

11. Process according to any of Claims 1 to 10 conducted with orifice of increasing dimension along its length, preferably increasing at a first angle with respect to the axis and optionally at a second angle in respect to the axis at the orifice outlet.

12. Process as claimed in any of claims 1 to 11 wherein an orifice is one of a plurality of orifices which may be independent or which may be adjacently or coaxially or concentrically aligned to form a plurality of simple extrudates or to form a composite extrudate as hereinbefore defined, and may additionally or alternatively comprise a solid core or the like, whereby hollow extrudate is obtained for example an annular orifice may provide tubes or cylinders.

13. Process according to any of Claims 1 to 12 wherein extrusion is into a collection zone at positive, ambient or negative pressure, which may be greater or less than the supercritical pressure and is preferably in the range 50 to 140 bar or in the range 1 to 50 bar.

14. Process according to any of Claims 1 to 13 wherein polymer substrate is selected from any amorphous, semi-crystalline or crystalline polymer, suitably polymers such as polyesters, poly (ortho esters), polyanhydrides, poly(amino acids), poly(pseudo amino acids), polyphosphazenes, azo polymers; vinyl polymers poly(acrylic acid), poly(methacrylic acid), polyacrylamides, polymethacrylamides, polyacrylates, Poly(ethylene glycol), Poly(dimethyl siloxane), Polyurethanes, epoxy, bis-maleimides, methacrylates such as methyl or glycidyl methacrylate, Polycarbonates, Polystyrene and derivatives; carbohydrates, polypeptides and proteins; and copolymers thereof.

15. Process according to any of Claims 1 to 14 wherein guest matter is selected from biofunctional or non-biofunctional material including but not limited to:

(1) (pharmaceutical) drugs and veterinary products;

(2) agrochemicals as pest and plant growth control agents;

(3) human and animal healthcare products;

(4) human and animal growth promoting, structural, or cosmetic products including products intended for growth or repair or modelling of the skeleton, organs, dental structure and the like;

(5) absorbent biofunctional materials for poisons, toxins and the like;

(6) functioning matter such as any nutrient dependent, biological matter which is characterised by replication, division, regencration, growth, proliferation or the like;

(7) organic or inorganic materials for use in dyeing, constructing textiles, electronic materials and the like;

(8) SMART materials.

(9) formulating agents which stabilise or enhance the functional material.

16. Process as claimed in any of claims 1 to 15 wherein guest matter is present in an amount of $1x10^{-12}$ to $1x10^{-6}$ or $1x10^{-6}$ to 1 wt%, more preferably in low volumes in the range $1x10^{-12}$ to $1x10^{-9}$, $1x10^{-9}$ to $1x10^{-6}$ or 0.01 or 0.1 to 1 wt%.

17. Process as claimed in any of claims 1 to 15 wherein guest matter is present in an amount of 1.0 wt% up to 50 wt%.

18. Polymer extrudate comprising polymer matrix and guest matter as hereinbefore defined in any of Claims 1 to 23 as a solid admixture in extrudate form in the form of tubes, cylinders, rods, ribbons, fibrils, filaments, fibroids or fibres, wherein the polymer matrix comprises polymer of molecular weight in the range 20 to 50 kDa or 50 to 200 kDa.

19. Polymer extrudate as claimed in Claim 18 suitable for topical, rectal, parenteral, mucosal, epicutaneous, subcutaneous, intravenous or intrarespiratory application route or as a structural implant in the human or animal body or in living matter wherein guest matter is present in an amount of $1x10^{-12}$ to $1x10^{-6}$ or $1x10^{-6}$ to 1 wt%, more preferably in low volumes in the range $1x10^{-12}$ to $1x10^{-9}$, $1x10^{-9}$ to $1x10^{-6}$ or 0.01 or 0.1 to 1 wt%.

20. Polymer extrudate as claimed in Claim 18 suitable for topical, rectal, parenteral, mucosal, epicutaneous, subcutaneous, intravenous or intrarespiratory application route or as a structural implant in the human or animal body or in living matter wherein guest matter is present in an amount of 1.0 wt% up to 50 wt%.

21. Apparatus for use in the preparation of polymer extrudate using the process as hereinbefore defined in any of Claims 1 to 17 comprising a pressure vessel adapted for temperature and pressure elevation which may comprise means for mixing the contents, and wherein the pressure vessel includes means for extruding contents via an orifice as hereinbefore defined into a second collection vessel at lower pressure.

22. Extrudate as claimed in any of Claims 18 to 20 or a composition thereof or a product of the process as claimed in any of Claims 1 to 17 for use as a controlled release device such as a drug delivery device; in Pharmaceutical or Veterinary applications for example as a human or animal health or growth promoting structural or cosmetic product, natural or artificial implant, drug delivery or DNA delivery device; as an anti-microbial for example having bacteria -static or -cidal activity; as a natural or synthetic barrier capable of immobilising e.g. naturally occurring or artificially introduced poisons or toxins by e.g. absorption, interaction or reaction; in Agrochemical or crop protection applications; in the processing of thermally labile fibres for use in dying, textiles, electronics etc below the polymer Tg, Tm or melt viscosity; in incorporation of dyes and other thermally labile materials into polymers that cannot be formed by traditional processes e.g. melt extrusion and the like; or in incorporation of surfactants into fibres to control polymer properties.

23. Process for preparing polymer extrudate comprising contacting a polymer substrate with a supercritical fluid under supercritical conditions of elevated temperature and/or pressure to plasticise the polymer substrate and extruding polymer substrate under supercritical conditions via an extrusion orifice into a collection zone or a mould with simultaneous or subsequent release of pressure, whereby extrudate is obtained in form conferred by the orifice or the mould in the

form of tubes, cylinders, rods, ribbons, fibrils, filaments, fibroids or fibres characterised in that the process is conducted at temperature of 30°C to 55°C and less than or equal to 140°C.

24. Process for preparing polymer extrudate comprising contacting a polymer substrate with a supercritical fluid under supercritical conditions of elevated temperature and/or pressure to plasticise the polymer substrate and extruding polymer substrate under supercritical conditions via an extrusion orifice into a collection zone or a mould with simultaneous or subsequent release of pressure, whereby extrudate is obtained in form conferred by the orifice or the mould in the form of sheets or films characterised in that the process is conducted at temperature of 30°C to 55°C and less than or equal to 140°C.

25. Process as claimed in Claim 23 or 24 wherein polymer substrate comprises a thermally labile polymer, for example, poly(acrylonitrile) and copolymers thereof.